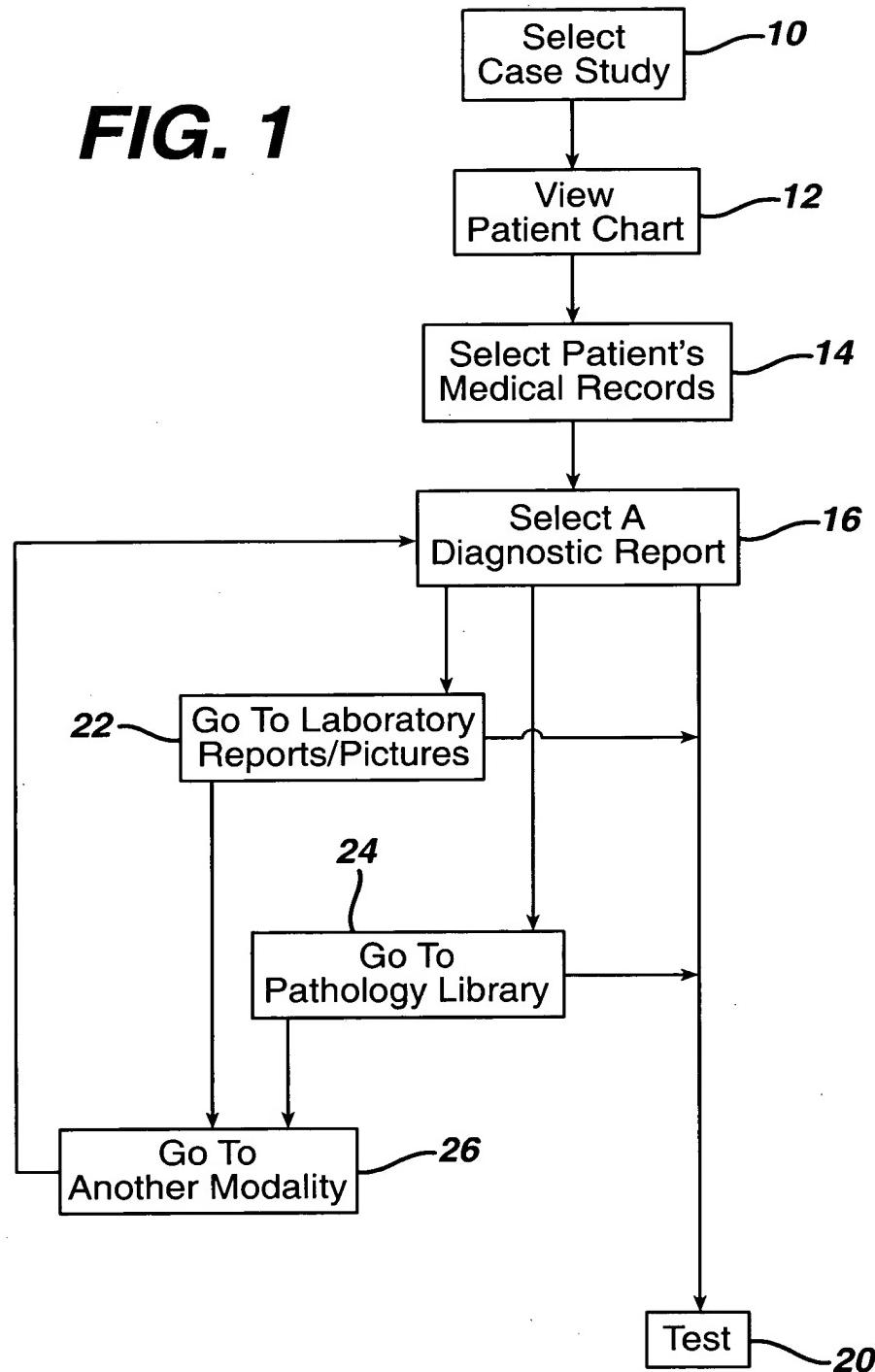


**FIG. 1**

# FIG. 2

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The screenshot shows a web browser window with the following details:

- Address Bar:** http://www.atl.com/ATLLearningCenter/OnlineCaseStudies/Vascular/vascintro.asp
- Menu Bar:** File, Edit, View, Favorites, Tools, Help
- Toolbar:** Back, Forward, Stop, Refresh, Home, Search, Favorites, History, Mail, Print, Edit
- Content Area:**
  - ATL Medical Systems Company Logo:** A stylized 'A' and 'T' logo.
  - Page Title:** WE ARE ULTRASOUND®
  - Navigation Links:** Home, Search, Store, Contact, About Us, Customer Care, Product Solutions, Advanced Apps, Learning Center, Employment.
  - Section Header:** Case Studies
  - Image:** A grayscale photograph of a medical ultrasound probe being used on a patient's arm.
  - Section Header:** Vascular
  - Text:** These case studies have been approved by the Society of Diagnostic Medical Sonographers for 1.0 credit. These credits are accepted for laboratory accreditation and are accepted by the ARDMS, AART (Category A), and AMA (Category II).
  - Section Header:** Learning Center
  - Links:** Case Studies, About Learning Center, ATL Conferences, Resource Guide, Interactive Learning, Image Library, Protocol Guides.
  - Section Header:** Vascular Case Study #1 - Calloid Body Tumor
  - Text:** Darrin Cournoyea, BSc, RDMS, RVT  
Peterborough Vascular Lab, Peterborough, Ontario, Canada
  - Section Header:** Vascular Case Study #2 - Right Popliteal Artery False Aneurysm with an Arterio-Venous Fistula
  - Text:** Darrin Cournoyea, BSc, RDMS, RVT  
Peterborough Vascular Lab, Peterborough, Ontario, Canada
- Right Sidebar:** Philips - Select Site

# FIG. 3

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**WE ARE ULTRASOUND**

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Learning Center

Case Studies

About Learning Center

ATL Conferences

Resource Guide

Interactive Learning

Image Library

Protocol Guide

File Edit View Favorites Tools Help

Back Forward Stop Refresh Home Search Favorites History Mail Print Edit

Address: http://www.atl.com/ATLlearningCenter/OnlineCaseStudies/Vascular/expan\_objective.asp

Home Search Site Index Content eStore

About Us Customer Care Product Solutions Advanced Apps Learning Center Employment

Medical Records Laboratory Pathology Nuclear Medicine X-Ray MRI Angiography Ultrasound Computed Tomography

The following learning exercise provides information regarding Carotid Body Tumor. The information is presented using a case study format. By reviewing the medical history and test results of several diagnostic modalities the characteristics of the pathology are examined.

Following the review of this information as well as the discussion provided in the library the learner will be able to:

1. Describe the role of ultrasound in the assessment of carotid body tumor.
2. List the typical ultrasound findings of carotid body tumor.
3. Describe the typical signs and symptoms of carotid body tumor.
4. List other pathologies that may be considered as a differential diagnosis for carotid body tumor.

At any time the personal notes button can be used to collect information regarding the pathology. These notes can then be printed as a summary of the case study for future reference. All practitioners of ultrasound can benefit from this case study review which illustrates the unique information that each imaging modality, clinical exam or test provides to reach a diagnostic conclusion.

The patient chart tabs above allow access to all test results. Please click on one to begin the case study review. When you feel you have collected adequate information from the test results and library please proceed to the test.

TEST

# FIG. 4

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Company

Address: <http://www.ATL.com/ATLearningCenter/OnlineCasesStudies/Vascular/MedicalHistory.asp>

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Medical Records | Laboratory Pathology | Nuclear Medicine | X-Ray | MRI | Angiography | Ultrasound | Computed Tomography

View Library ►

QUICK SEARCH

Learning Center

- Case Studies
- About Learning Center
- ATL Conferences
- Resource Guide
- Interactive Learning
- Image Library
- Protocol Guide

**Clinical History:** The patient is an obese female born in 1932. She quit smoking cigarettes in 1993 but did smoke for 45 pack years. She is currently taking medication to control hypertension, hyperlipidemia, diabetes mellitus, and the occasional angina attack. She has a strong family history of diabetes and atherosclerotic disease. The patient had a right common iliac artery transluminal dilatation in 1987, an appendectomy in 1942 and a previous problem with peptic ulcers in 1975.

The patient is asymptomatic, but has been experiencing some intermittent bilateral eye blurriness in the last month, possibly related to her diabetes. Blood pressure is 154/90 and no carotid bruits are present. The chest is clear and no abnormal abdominal palpations felt. Pulses for the carotid, radial, femoral and popliteal arteries are a 2+. The pedal pulses are weak with a grading of 1.

**Exam Report:** Considering the patient's strong family history of atherosclerotic disease and the patient's own risk factors such as hypertension, hyperlipidemia, diabetes, peripheral vascular disease, coronary artery disease, obesity and smoking, a carotid artery Doppler ultrasound has been ordered to assess the carotid arteries.

**Medications:** Acetylsalicylic Acid, Atenolol, Docusate Sodium, Zocor, Estrogen, Provera, Oxazepam, Kennal, Quinine Sulphate, Nitrodur Patch, Metformin and Glyburide.

TEST

# FIG. 5

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**Examination Report- Cerebral Angiography**

The study was carried out from a right femoral puncture and no complications were encountered. At the end of the procedure, the patient had noticed some numbness in the right foot. This actually had occurred during the examination, fairly early on and this was likely due to a partial anesthesia of the femoral nerve.

The patient developed a bit of numbness in the right hand, predominantly in the third periphery of the digits towards the end of the procedure. This may have been related to spasm in the left vertebral artery, which did occur during the examination. It is possible that a small embolus occurred during catheterization of the left cerebral vessels, but her vessels are quite smooth and the catheterizations went quite easily. In any case, both of these symptoms were resolving as the patient was being observed in the surgical outpatient unit.

Selective right carotid and right vertebral angiography revealed relatively normal vessels. In particular, there was no collateral flow from branches of these vessels over to the lesion adjacent to the left carotid bifurcation.

Selective left vertebral angiography did not reveal any abnormalities or supply to the above mentioned left carotid bifurcation tumor.

**TEST**

# FIG. 6

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<p>File Edit View Favorites Tools Help</p> <p>Back Forward Stop Refresh Home Search Favorites History Mail Print Edit</p> <p>Address: <a href="http://www.atl.com/ATLLearningCenter/OnlineCaseStudies/Vascular/pathanddb.asp">http://www.atl.com/ATLLearningCenter/OnlineCaseStudies/Vascular/pathanddb.asp</a></p>	<p><b>WE ARE ULTRASOUND</b></p> <p>World's Largest Ultrasound Center</p> <p>eStore</p> <p>A Philips Medical Systems Company</p> <p>Customer Care Product Solutions Advanced Apps Learning Center Employment</p> <p>36</p> <p>38</p> <p>Medical Records Laboratory Pathology Nuclear Medicine X-Ray MRI Angiography Ultrasound Computed Tomography</p> <p>Quick Search</p> <p>View Library</p> <p><b>Pathology Report</b></p> <p><b>Pathology Report of Left Neck Mass</b></p> <p><b>Gross:</b> The specimen is submitted in a single container and consists of a fleshy burgundy colored portion of tissue measuring up to <math>1.5 \times 1.1 \times 0.8</math> cm. Tissue weighs 1.0 gm. On sectioning, a firm kidney-bean shaped area is present measuring <math>1.1 \times 0.7</math> cm. The cut surface is tan/red in color.</p> <p><b>Microscopic:</b> Sections show a well circumscribed encapsulated lesion surrounded by fibrovascular stroma. The lesion appears to be completely excised.</p> <p><b>It</b> consists predominantly of cords of cells in a markedly vascular stroma. The cells have oval to irregular nuclei with finely granular chromatin and small nuclei. Zellballen pattern is focally evident.</p> <p><b>DIAGNOSIS:</b> CAROTID BODY TUMOR (PARAGANGLIOMA)</p> <p><b>Blood and Urinalysis Laboratory Results</b></p> <p>Blood Results</p> <p>Urinalysis Results</p> <p>Result Reference Range: <b>TEST</b></p>
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# FIG. 7

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The screenshot shows a web browser window with the following details:

- Address Bar:** http://www.all.com/ATIlearningCenter/OnlineCaseStudies/vascular/Library.asp
- Title Bar:** WE ARE ULTRASOUND
- Header:**
  - Philips Medical Systems Company
  - Customer Support
  - eStore
  - Product Solutions
  - Advanced Apps
  - Learning Center
  - Employment
- Left Sidebar:**
  - QUICK SEARCH
  - Learning Center
  - Case Studies
  - About Learning Center
  - ATL Conferences
  - Resource Guide
  - Interactive Learning
  - Image Library
  - Protocol Guides
- Right Sidebar:**
  - Laboratory Pathology
  - Nuclear Medicine
  - X-Ray
  - MRI
  - Angiography
  - Ultrasound
  - Computed Tomography
- Content Area:**

**Discussion on Carotid Body Tumors**

**What is a Carotid Body Tumor?**

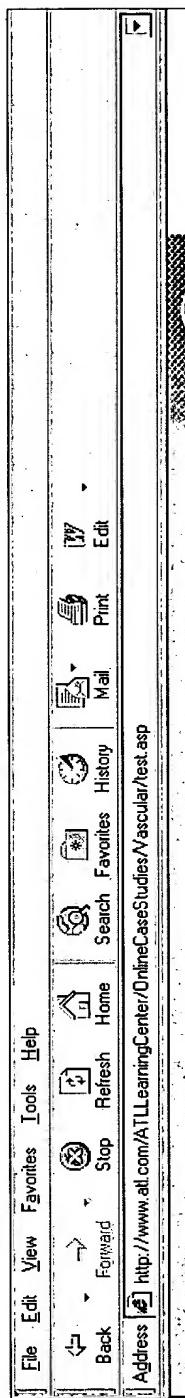
A carotid body tumor (CBT) is a neoplasm of a carotid body chemoreceptor located at the bifurcation of the common carotid artery into the internal carotid and external carotid arteries. The normal size of a carotid body is  $5 \times 3 \times 2$  mm. This slow growing tumor has a rich vascular supply fed primarily by the ECA and its branches. The vertebral and thyrocervical arteries can also feed these tumors. Percutaneous needle aspiration of these tumors is strongly contraindicated due to the risk of hemorrhage. The tumor does not have a true capsule but is well circumscribed. Its color is reddish brown and has a rubbery consistency. The tumor sits in the notch between the ICA and ECA, therefore as the tumor grows it spays these arteries.

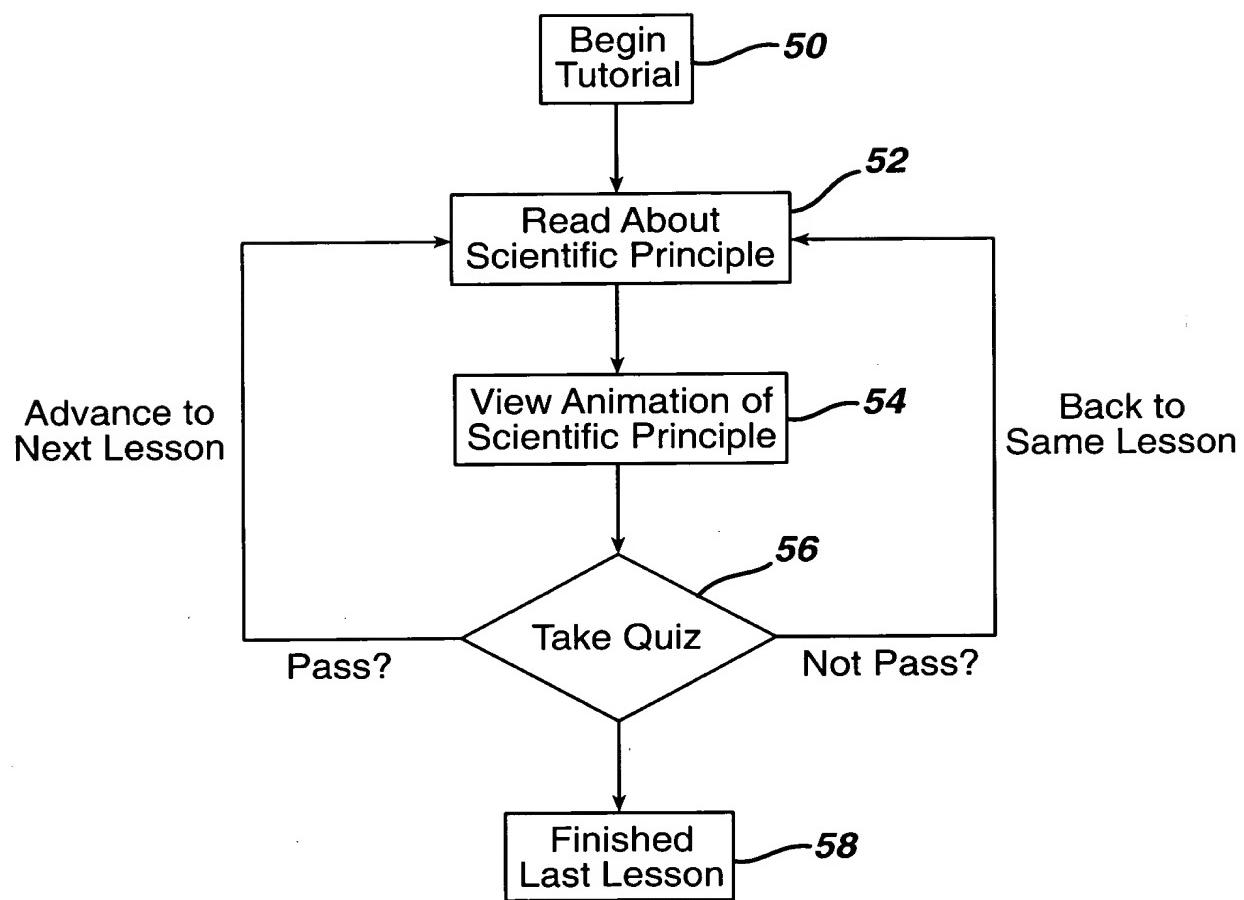
CBTs have been classified and described into 3 groups based on anatomic observations. Group I tumors are small and easily removed because they are not well adhered to the carotid vessels. Group II tumors are moderately larger with more difficult surgical excisions due to more extensive attachments. Group III tumors are very large and completely involve both the ICA and ECA. Complete arterial resection and grafting is often necessary.

CBTs are slow growing benign tumors that may be familial (autosomal dominant) or idiopathic. CBTs are usually unilateral but can also be bilateral with a 5% incidence for sporadic tumors and a **TEST**.

# FIG. 8

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 <p>File Edit View Favorites Tools Help</p> <p>Back Forward Stop Refresh Home Search Favorites History Print Mail Edit</p> <p>Address http://www.atl.com/ATLLearningCenter/OnlineCaseStudies/Vascular/test.asp</p>	<p><b>WE ARE ULTRASOUND</b></p> <p>Home Search Contact eStore</p> <p>About Us Customer Care Product Solutions Advanced Apps Learning Center Employment</p> <p>Medical Records Laboratory Pathology Nuclear Medicine X-Ray MRI Angiography Ultrasound Computed Tomography</p> <p>QUICK SEARCH</p> <p>Learning Center</p> <p>Case Studies About Learning Center ATL Conferences Resource Guide Interactive Learning Image Library Protocol Guides</p>		
<p><b>TEST</b></p> <p>The following test is multiple choice. Select the answer for each question by clicking on the button preceding your choice. A passing score is 70% correct answers.</p> <p><b>Question 1</b></p> <p>The vascular area demonstrated with the angiogram at the left carotid bifurcation would most likely be fed by?</p> <p> <input type="radio"/> Branches off the internal carotid artery  <input type="radio"/> Branches off the external carotid artery  <input type="radio"/> Branches off the vertebral artery  <input type="radio"/> Branches off the thyrocervical artery     </p> <p><b>Question 2</b></p> <p>The carotid body tumor is typically located between the:</p> <p> <input type="radio"/> vertebral and subclavian arteries  <input type="radio"/> carotid and subclavian arteries  <input type="radio"/> external carotid and common carotid arteries  <input type="radio"/> external carotid and internal carotid arteries     </p> <p><b>Question 3</b></p> <p>A carotid body tumor can be identified with ultrasound as</p> <p>a:</p>			

**FIG. 9**

# FIG. 10

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The screenshot shows a web browser window with the following details:

- Address Bar:** http://learn.pheno.com/phenox/module/main.asp?mid=24&mscid=FX2G730P2CSR2SF40U74M0w04D79E68
- Toolbar:** Back, Forward, Stop, Refresh, Favorites, Search, History.
- Content Area:**
  - Title:** Doppler in Ultrasound Applications : Home Page
  - Navigation Links:** OBJECTIVES, OUTLINE, SEARCH, GLOSSARY, TEST, HOME, YOUR HOME, COUPLE HOME.
  - Text:** You have until September 12, 2001 to pass the test for this module before it expires.
  - Section Headers:** LEARNING OBJECTIVES, OUTLINE/STUDY CONTENT, SEARCH, GLOSSARY, ASSESSMENT TEST.
  - Content Description:** A concise overview of the current module. Displays a listing of the topics. Please review *all* of these topics before taking the assessment test. Search by keyword or phrase. Vocabulary for the current module. Once you have studied all sections in this module, click here to take the test.
  - Background Image:** A grayscale image of a Doppler ultrasound scan showing blood vessels and flow patterns.

# FIG. 11

**Doppler in Ultrasound Applications : Study Content**

Address <http://learn.physica.com/physca/module/section.asp?mid=244&sid=105&mscid=FX2673D02CSR2G400174MQW04D75E6B>

OBJECTIVES OUTLINE SEARCH GLOSSARY TEST YOUR HOME MODULE HOME

**Doppler Effect**  
Page 10 of 26

BACK PAGE NEXT PAGE

**Components of Doppler Equation**

Doppler ultrasound transducers use two piezoelectric elements, one to transmit ultrasound  $F_t$  and one to listen for returning echoes from the moving blood cells  $F_r$ . {68}

The factor 2 is present to account for the fact that the Doppler effect actually occurs twice. The first Doppler effect occurs when the transducer is the stationary source of the sound wave and the moving blood cells are the receivers. The second Doppler effect occurs when ultrasound is reflected from the blood cells. The blood cells act as a moving source of sound waves and the transducer acts as a stationary receiver.

$v = \text{the velocity of the blood (what we are trying to determine)}$

# FIG. 12

**Doppler in Ultrasound Applications : Study Content**

OBJECTIVES OUTLINE SEARCH GLOSSARY TEST HOME MODULE HOME

**Doppler Effect**

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◀ BACK PAGE ▶ NEXT PAGE

**Pulsed Wave Doppler**

Pulsed wave Doppler ultrasound uses a single piezoelectric crystal for both transmission and reception of sound waves. The system transmits short pulses of sound waves at regular intervals. It then waits for a specified time and only then receives signals from a certain depth. This is similar to pulse-echo imaging. Using this technique, the depth from which the signal originated can be calculated.

The diagram illustrates the pulsed wave Doppler cycle. It shows three stages: A (transmit), B (wait), and C (receive). Stage A is represented by a probe icon with a vertical line labeled '72'. Stage B is represented by a probe icon with a horizontal line labeled '66''. Stage C is represented by a probe icon with a curved arrow pointing towards a circular receiver area labeled '60'. Above the stages, a bracket indicates a total duration of '68'' for the entire cycle.

FIG. 13

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The image consists of two main parts. On the left, there is a screenshot of a web browser window. The address bar shows the URL "http://learn.phcna.com/phcna/module/section.asp?mid=24&sid=100&msid=FX2G73DP20SR26F400174N0W04D79E68". The main content area displays a page titled "Doppler in Ultrasound Applications : Study Content". This page includes a navigation bar with links for "OBJECTIVES", "OUTLINE", "SEARCH", "GLOSSARY", and "TEST". Below the navigation bar are several large, faint circular icons. A vertical sidebar on the right contains links for "HOME", "YOUR HOME", "MODULE HOME", and "NEXT PAGE". At the bottom of the browser screenshot, there are standard browser control buttons for back, forward, and search. On the right side of the image, there is a separate page titled "Quiz". The title is written vertically in a large, bold font. Below the title, the text "Race fan 2 is here X" is displayed. The background of this page features a stylized illustration of a race track with a car and some text.

# FIG. 14

14/14

Address: <http://learn.pheno.com/phenomena/module/section.asp?mid=250&mcssid=FX2G73D92CSRGE00U7MQW04D79E6B>

## Doppler Ultrasound Signal Analysis and Optimization : Study Content

OBJECTIVES OUTLINE SEARCH GLOSSARY TEST HOME

Analysis of Doppler Signal

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### Maximum Velocity Measurements

The Doppler equation can be used in duplex imaging to convert frequencies into velocities. This is because the angle between the Doppler beam and the blood vessel can be estimated. Analysis of the components of the Doppler waveform shows that many velocities are displayed in the spectrum and these velocities vary with time, due to the cardiac cycle.

The value most commonly used for the measurement of velocity is peak systolic flow. This is the maximum velocity in the spectrum at peak systole. Maximum velocity can also be measured at end diastole. These velocity measurements represent the fastest moving blood flow in the center of the vessel and do not include the slower moving flow near the vessel wall.

80

160

Drag the red dot into the highlighted area and drop it